Chapter 10
Sustainable Energy Generation From Waste Water:
IoT Integrated Technologies

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ABSTRACT

This chapter investigates the conversion of wastewater into sustainable energy through the use of novel methods such as anaerobic digestion, microbial fuel cells, geothermal desalination, and internet of things (IoT) integration. It underlines the significance of wastewater treatment and energy sustainability, as well as the need for cost-effective solutions. IoT for real-time data collecting, analysis, and control can help with sustainable wastewater treatment and energy generation. Anaerobic

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digestion generates biogas, whereas microbial fuel cells convert organic molecules into energy. Geothermal desalination provides low-cost energy efficiency. IoT technology enhances performance, lowers energy consumption, and allows for remote monitoring and maintenance, all of which contribute to a more sustainable and resilient future.

INTRODUCTION

Wastewater treatment is crucial for environmental health and public safety. The plants remove pollutants and ensure purity and cleanness' of water, but they consume energy, causing operational costs and carbon emissions. Researchers are exploring renewable energy sources like anaerobic digestion, microbial fuel cells, and geothermal desalination. The chapter also discusses the integration of IoT in these processes for enhanced efficiency and environmental benefits. Anaerobic digestion is a technology that uses microorganisms to break down organic matter in wastewater without oxygen, producing biogas as a by-product. This process converts organic waste into biogas, which can be used as a renewable energy source for electricity generation and heat production. Implementing anaerobic digestion in wastewater treatment plants not only manages organic waste but also recovers valuable energy, reducing reliance on non-renewable resources (Llácer-Iglesias et al., 2021).

Microbial Fuel Cells (MFCs) are a promising technology for sustainable energy production from wastewater. They use microorganisms' metabolic activities to generate electricity, allowing continuous electricity generation. MFCs have potential in wastewater treatment systems, offering simultaneous pollutant removal and energy recovery. Research aims to improve MFC performance and scalability for practical applications. Geothermal desalination is an innovative approach that combines geothermal energy with desalination processes, converting seawater or brackish water into freshwater. This approach offers high energy efficiency and reduced dependence on fossil fuels, addressing freshwater scarcity and generating renewable energy simultaneously (Chandrasekhar et al., 2020).

IoT technology improves bioenergy generation efficiency by enabling real-time monitoring, data collection, and analysis of parameters in anaerobic digestion, MFCs, and geothermal desalination systems. Operators can remotely monitor process variables, identify issues, and optimize energy production and water treatment efficiency (Boopathi & Myilsamy, 2021; Haribalaji et al., 2021; Sampath et al., 2022). IoT-based control and automation systems offer improved operational management, reduced energy consumption, and predictive maintenance, leading to